(No Model.) 2 Sheets—Sheet 1.

D. R. BAKER.

MOTOR.

No. 366,551. Patented July 12, 1887.

Fig. 1.

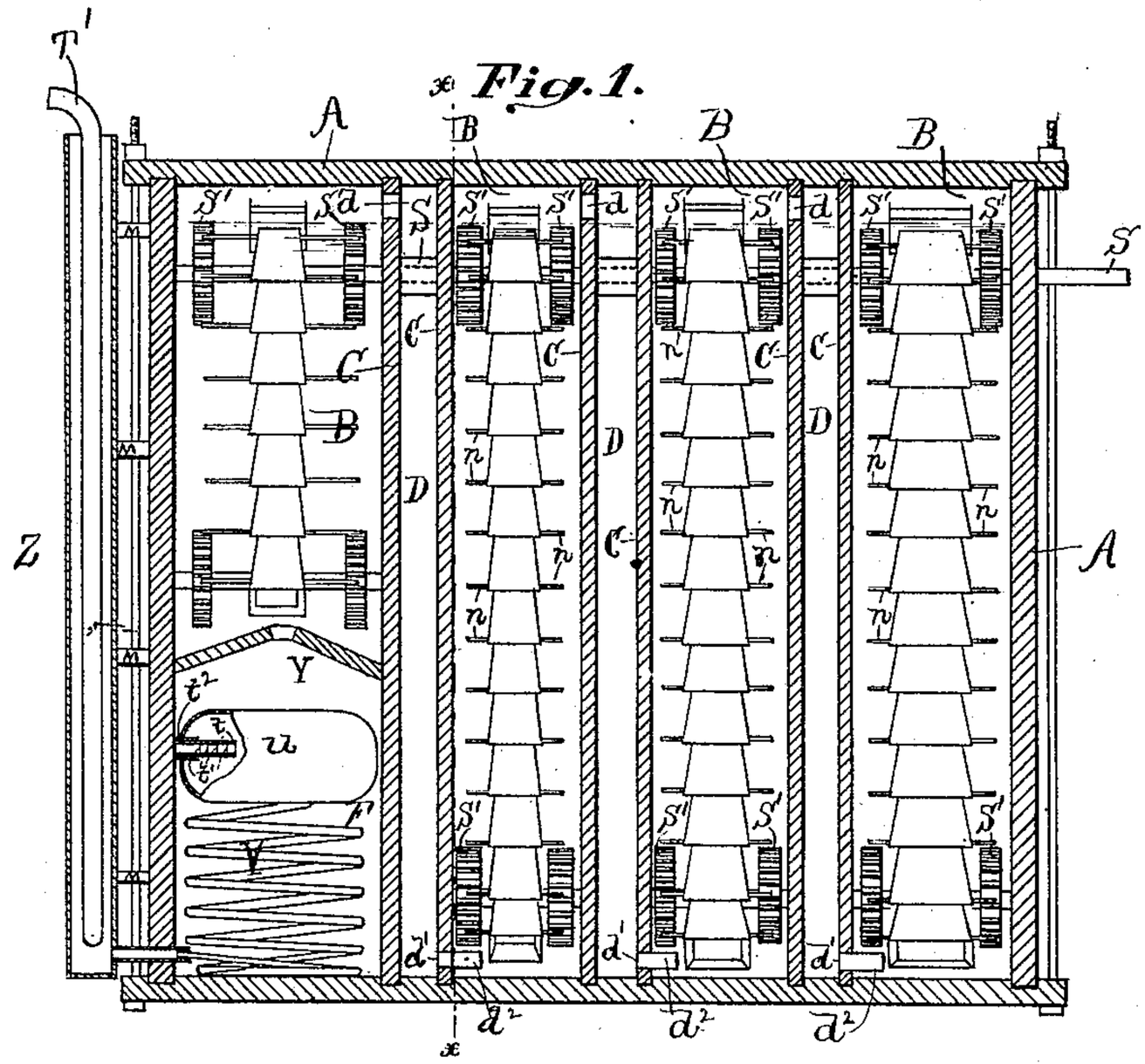
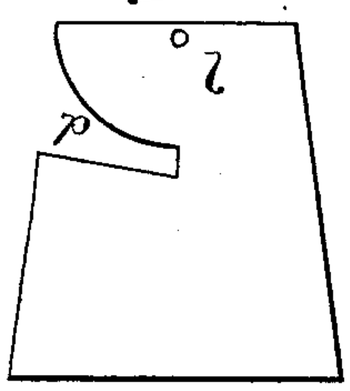


Fig. 3.



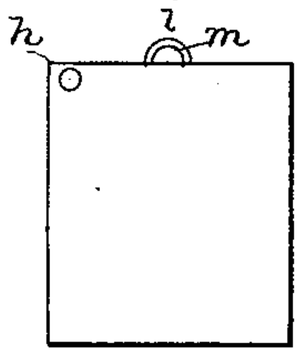
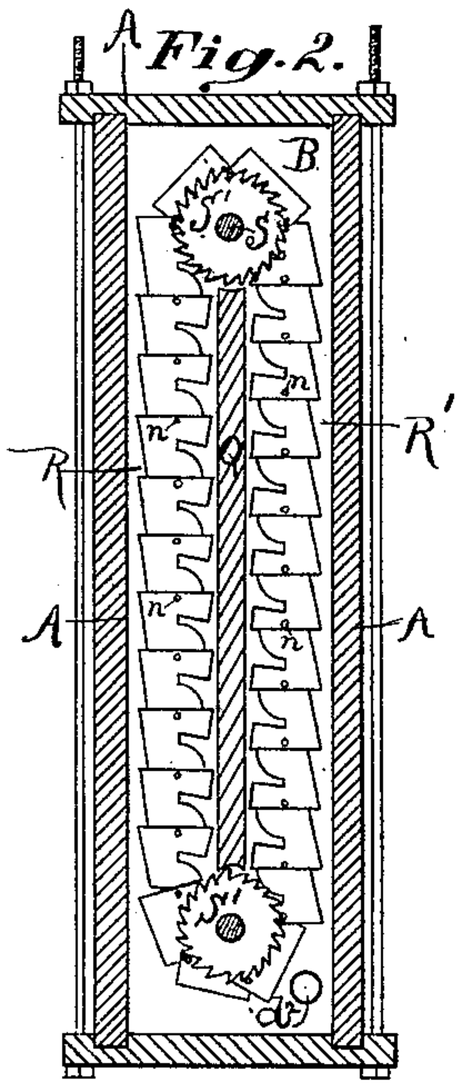


Fig. 5.

Fig. 2.



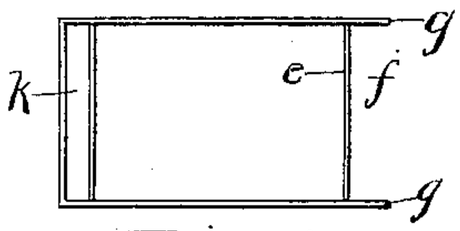
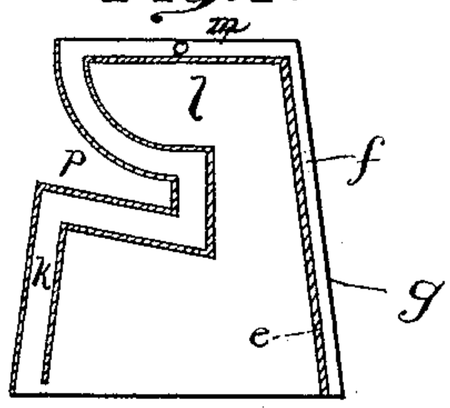


Fig. 7.

Fig. 4.



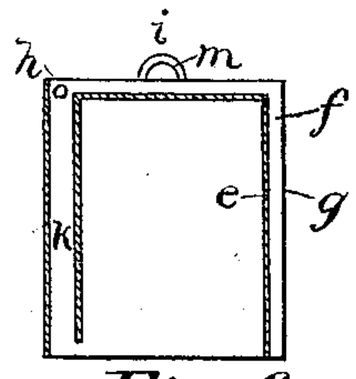


Fig. 6.

Attest

W. P. Gulick

E. W. Harmon.

Inventor

Delos R. Baker

per Wm. Hubbell Fisher,

Atty.

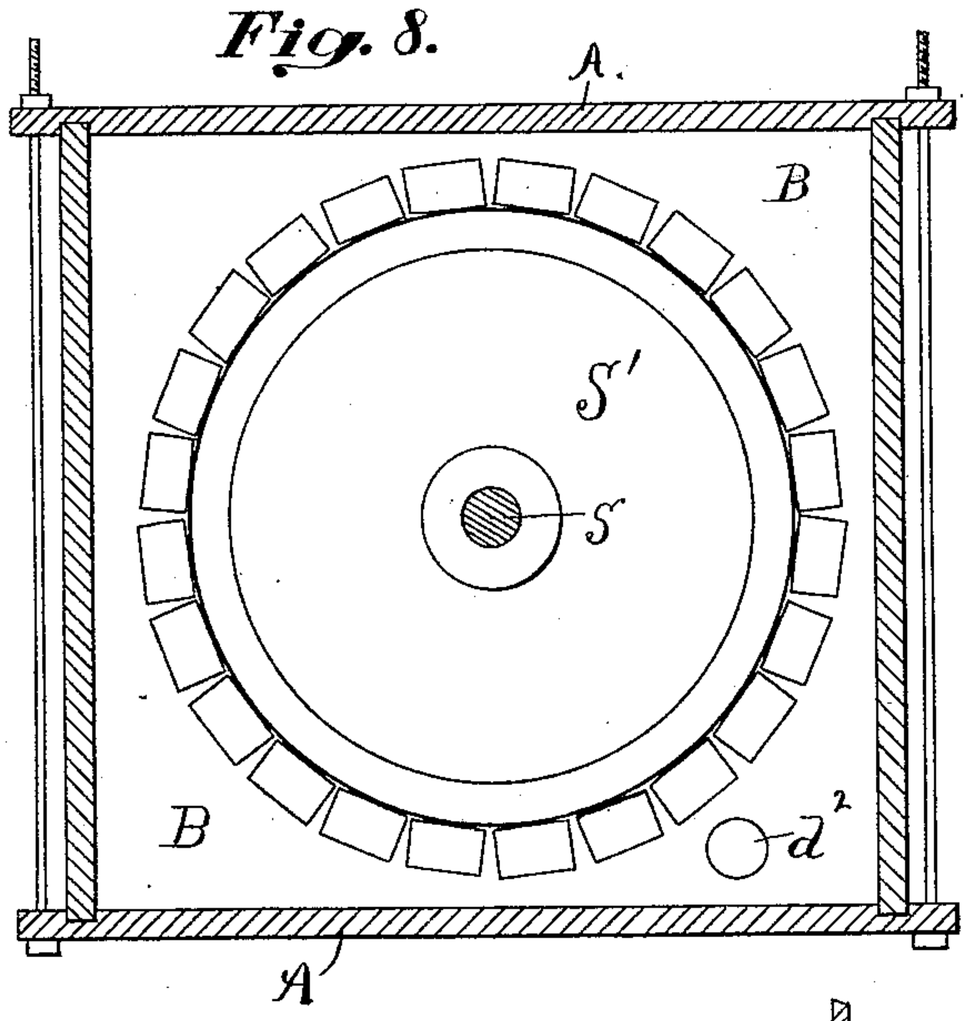
(No Model.) 2 Sheets—Sheet 2.

D. R. BAKER.

MOTOR.

No. 366,551. Patented July 12, 1887.

Fig. 8.



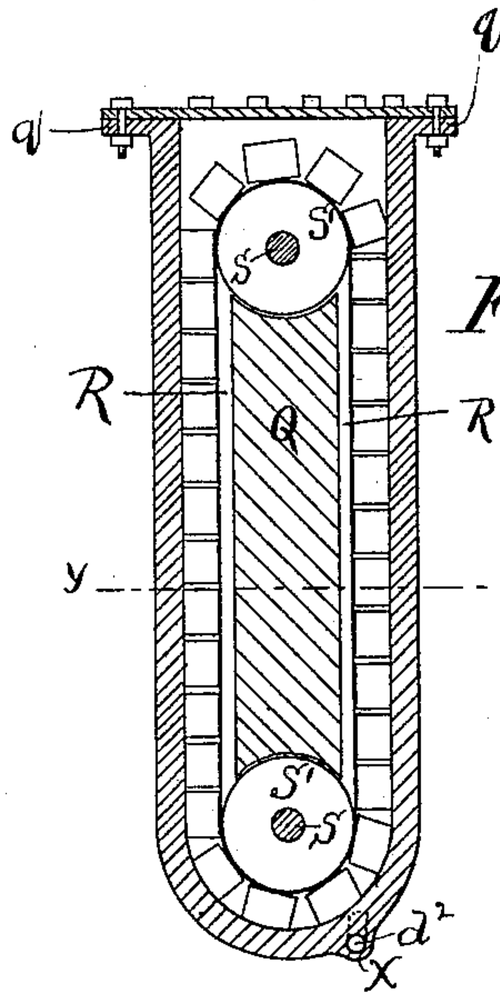


Fig. 9.

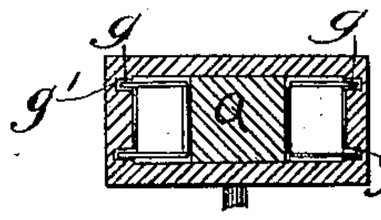


Fig. 10.

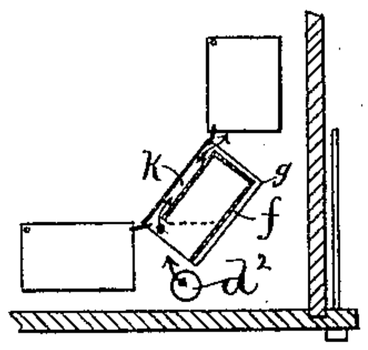
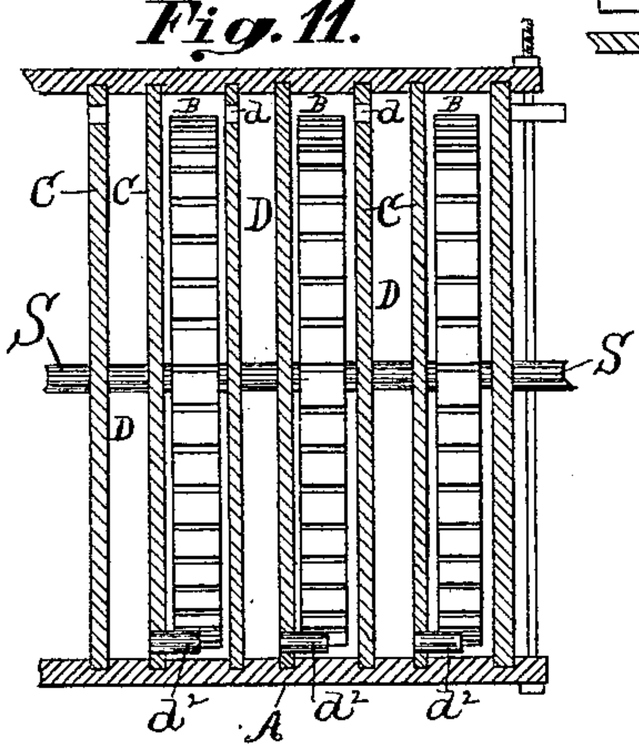


Fig. 13.

Fig. 11.



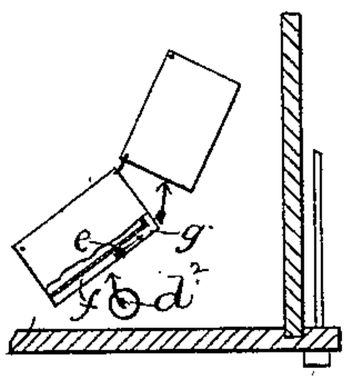


Fig. 14.

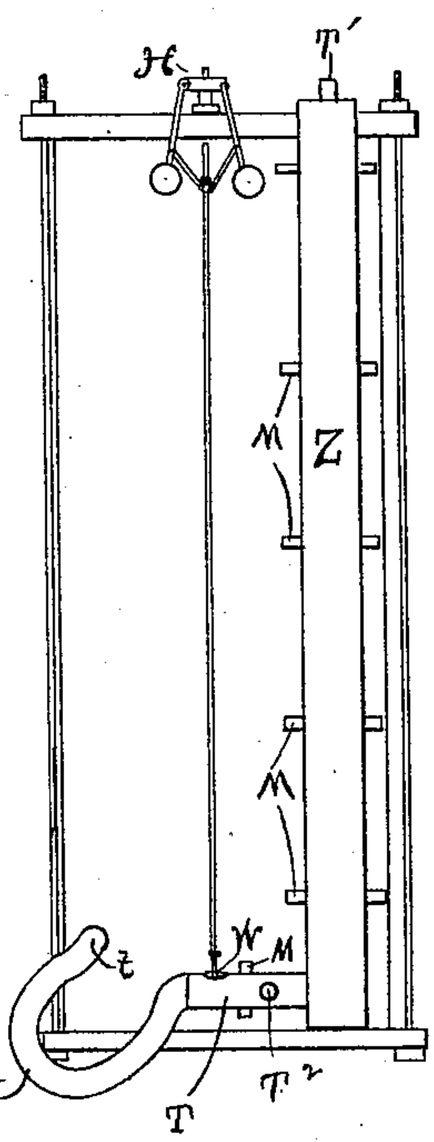


Fig. 12.

Attest
W. P. Gulick
Em. Harmon

Inventor
Delos R. Baker
per Wm. Hubbell Fisher,
Atty.

UNITED STATES PATENT OFFICE.

DELOS R. BAKER, OF CINCINNATI, OHIO.

MOTOR.

SPECIFICATION forming part of Letters Patent No. 366,551, dated July 12, 1887.

Application filed July 31, 1886. Serial No. 209,706. (No model.)

To all whom it may concern:

Be it known that I, DELOS R. BAKER, a citizen of the United States, and a resident of the city of Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Motors, of which the following is a specification.

The several features of my invention and the advantages arising from their use, conjointly or otherwise, will be apparent from following description and claims.

In the accompanying drawings, making part of this specification, Figure 1 represents an elevation of an apparatus embodying my invention, the front side of the apparatus being removed. Fig. 2 represents a transverse section taken at the line *x x* of Fig. 1, looking from the left to right. Fig. 3 represents a side elevation of one bucket of the endless series of buckets shown in Figs. 1 and 2. Fig. 4 is a vertical central section of one of said buckets. Fig. 5 represents the preferred form of bucket when buckets are of small size. Fig. 6 is a vertical central section of bucket shown in Fig. 5. Fig. 7 represents a bottom view of the bucket shown in Figs. 3, 4, 5, and 6. Fig. 8 is a modification of my device, showing the buckets rigidly attached to the periphery of a wheel. Fig. 9 is the preferred form of compartment when made of cast metal, showing also the buckets attached to a belt running around the pulleys. Fig. 10 is a horizontal section of the device represented in Fig. 9, taken at the line Y Y, (the buckets remaining in elevation,) showing the grooves in which flanges *g* of the bucket can move. Fig. 11 represents three compartments fitted with the device shown in Fig. 8. Fig. 12 is an elevation of the left-hand side of Fig. 1, showing the regenerator, governor, and pipes conveying the gaseous fuel and supporter of combustion to the combustion-chamber. Figs. 13 and 14 show the course of the actuating submerged gas or vapor in its passage from bucket to bucket of the endless series of buckets.

In its simplest form this invention consists as follows, viz: An endless series of buckets revolving in a nearly or quite vertical plane in a bath of any desired liquid. Into the lower of these buckets, which are bottom side up, a gas—such, for example, as steam or other gas—or a vapor—as, for example, aqueous vapor, gasoline vapor, or other vapors—or a mixture of several gases or vapors—such, for example, as the mixture of the gases of combustion with steam—is introduced to operate the said series of buckets by the difference in weight between the buckets thus filled and those opposite filled with the heavier fluid of the bath in which the series of buckets is more or less completely immersed; or a rarefied liquid—such, for example, as that of the bath itself when rarefied by heat—may be introduced into the lower of the buckets to operate the series of buckets. This series of buckets may be attached to the periphery of a wheel partially or wholly immersed in the bath, or it may constitute an endless chain running around pulleys, usually two in number—viz., an upper pulley and a lower pulley—and communicating its motion to the said pulley, thereby changing the vertical movement of the chain into a rotary one, which, through the medium of the pulleys, is utilized to give motion to any desired machinery by means of the shaft of the pulley. The shaft may be provided with suitable gear, pulley-wheels, or crank, or other device for imparting power to machinery. Such a column of liquid used as a bath for a series of buckets, and the endless series of buckets immersed therein, and the pulley upon and around which it revolves, are shown in Figs. 1, 2, 8, 9, and 11.

The height of the column of liquid required to give any considerable or economical power by means of such a series of buckets and their attachments aforedescribed is in many cases and for many purposes inconvenient; also, the buckets of the whole chain of buckets in such a long column have to be larger than would be required in the earlier of a series of suitably-connected shorter columns of the liquid each fitted with its separate series of buckets, and all so communicating that the lighter operating-fluid, whatever it may be, shall pass *seriatim* from near the bottom to the top of all the columns from the first to the last. This increased size of the bucket is necessary in order to accommodate the expansion of the lifting gas, vapor, or rarefied liquid as each bucket containing it nears the top of the bath, where, as is well known, the pressure is less than nearer the bottom of the bath, this difference in pressure being nearly proportional to the height of the liquid

column. To obviate these and other disadvantages, and to secure additional positive advantages of lightness, compactness, cheapness of construction, and the like, it is in many cases desirable to divide into sections or divisions the column of liquid aforementioned. Such a series of sections or divisions inclosed in adjoining compartments is shown in Figs. 1 and 11, each with its respective series of buckets and attachments. In such an arrangement the actuating steam, vapor, or other gas passes from the top of the first compartment in which it has been used in operating the series of buckets in that compartment to or near the bottom of the next adjoining compartment. It then passes in the buckets of that compartment up to the surface of the immersing-bath therein, operating the series of buckets of that compartment. The actuating steam, gas, or vapor then passes to or near the bottom of the next adjoining compartment in which it then similarly operates, and so on from compartment to compartment until the actuating steam, gas, or vapor shall have reached the surface of the immersing-bath of the last of the series of compartments, whence it passes either to the outside air or to a condenser.

I will now describe certain details of my invention, in connection with a fuller description of the apparatus shown in the accompanying drawings.

A indicates the case, made of any suitable material, as wood, iron, glass, &c. It is made either of adiathermic material, or, if of other material, it is to be protected by a jacket of adiathermic material. There are present in this case one or more (preferably a number) of compartments, B, as shown, provided with walls C. Each compartment is connected with the next adjacent compartment by means of a conduit or passage-way, D, leading from the top of one compartment to the bottom of the succeeding one of the series. These passage-ways D may consist of a pipe or pipes, or, as is shown in the drawings, consist, principally, of a space between the walls C C of adjacent compartments B, and of the pipe d^2, hereinafter mentioned. For this purpose the first of these walls C is provided, near its top, with perforation *d*, and the second wall C with a corresponding perforation, *d'*, near the bottom, fitted with a pipe, d^2, which pipe leads to a point in the compartment under the proper side of the chain of buckets, so that the actuating gas or vapor fed through the pipe d^2 ascends into the open mouth of the bucket above it.

If the buckets are small, they are preferably formed as follows, (see Figs. 5 and 6,) viz: Each bucket is provided on its outer face, *e*—viz., that face farthest from the center of revolution of the series of buckets—with a channel, *f*. The length of this channel is nearly or quite parallel to the general direction of the line of the bucket's motion. This channel may be formed by flanges *g g*, projecting from the face *e;* or the channel may be recessed in the face or otherwise formed. The design of this channel is to conduct upward into the next bucket any actuating steam or other gas or vapor or rarefied liquid, which in certain points of the bucket's revolution may impinge on that face of the said bucket, as will be more particularly noticed when I come to describe the operation of the motor. If buckets of this form be used, they may be either linked together *seriatim* at their inner corners, *h h*, so as to make a continuous chain, or they may be linked together in a line joining their centers, as at *i i*, Figs. 5 and 6; or they may be rigidly attached to the periphery of a wheel, as in Figs. 8 and 11, or otherwise connected together. That part of the bucket which is nearest the center of revolution is provided with a conduit or passage-way, *k*, closed except at its top and bottom. This conduit begins (on or in the rear part of the bucket) near to, but a little distance from, the bottom edge of said rear part. Any excess of steam or other actuating-fluid in the bucket is directed by means of this conduit up into the bucket immediately above in the series of buckets. It being desirable to connect together the buckets with as little space intervening between the adjacent buckets as possible, and it also being desirable, if large buckets are used in a chain, to connect them together as near as possible to the line joining their centers, I have devised the form of bucket shown in Figs. 3 and 4. This form differs from that shown in Figs. 5 and 6 principally in two particulars, viz: First, the closed end *l* of the bucket is smaller than the open end thereof, in order that it (said end *l*) may be inserted into the open end of the bucket immediately preceding it, and in such a manner as to allow partial rotation of each of said buckets on a center of rotation common to it and its predecessor or successor, respectively. Projections, as *m*, (see Figs. 5 and 6,) from the closed end of the bucket are provided. These projections *m* may be lugs, (see Figs. 5 and 6,) or they may be extensions of two opposite sides of the buckets. (See Fig. 4.) Through these projections *m* passes the rod *n*, upon which the buckets partially rotate during certain stages of the revolution of the chain of buckets. This rod *n* is preferably fixed to the two opposite sides of the open end of the preceding buckets, and extends beyond said sides for a purpose hereinafter named. The points of junction between the said sides of the bucket and this rod may be hermetically sealed or packed. Upon this rod, so located and so attached, this preceding bucket and the bucket next following partially rotates. This form of bucket also differs from that shown in Figs. 5 and 6 in the second particular, viz: To accommodate that face of the bucket nearest the center of revolution in the partial rotation of the said bucket about the pivot connecting it to the next preceding bucket, the said face is recessed, as shown at *p*, Figs. 3 and 4. This recess *p* produces a corresponding flexure of the conduit *k*, substantially as shown in Fig. 4.

The connection between each chain of buckets and the pulleys upon which it revolves may be made in any desired or well known way. I have shown one form of this connection in Figs. 8 and 11, in which the buckets are attached to the periphery of the wheel. Another form is shown in Figs. 1 and 2, in which the large-sized buckets are used. In this instance the connection is made by the two projecting ends of the rods *n*, which join the buckets together in the chain. The ends of this rod drop into suitable recesses in or between suitable projections of the double disks or wheels S′ of the pulley, between which disks the chain of buckets revolves around the common shaft S of the said disks. This shaft is suitably supported in position, preferably to the sides of the compartment in which the chain of buckets revolves. These buckets may be made of any desired material adapted to the purpose for which they are intended and to the nature of the fluid of the bath in which they are immersed and through which they revolve. In case this bath be composed of mercury, I would make the buckets of iron, glass, porcelain, aluminum, or other non-amalgamating substance.

I would remark in passing that the walls of each compartment containing the bath should also be chosen as to its material with reference to the nature of the material used as a bath.

It is desirable that the endless chain of buckets should traverse two vertical channels, R R′, only so much larger than the chain of buckets passing through them as may be necessary to equalize the height of the bath. For this purpose I fill up the space inclosed by the chain of buckets by either a hollow box or by a solid piece, Q. (See Figs. 2, 9, and 10.) In either case channels are provided therein for the disks around which the chain of buckets revolves. When the channel *f* of the bucket is formed by the flanges *g g* on the face *e*, it is sometimes desirable to make grooves *g′* in the two opposite walls of the compartment. (See Fig. 10.) Each of these grooves will receive its respective flange *g*, and the latter will run in said groove.

When it is desirable to economize as much as possible the quantity of liquid used as a bath, each compartment may be cast of one solid piece, as shown in Fig. 9, and this piece or shell may have an offset, X, penetrated by the pipe which supplies the actuating gas or vapor. The top of such a compartment may be bolted to flange *q*, cast to the top of said compartment, suitable packing being interposed between the top and flange, if so desired.

Either of the upper or the lower of the pulleys, or both, in each compartment is suitably connected to a shaft, which shaft conveys motion derived from the buckets to the machinery to be operated or to whatever place or purpose the motion is to be applied.

If there are more than one of the revolving chains of buckets, either all in one compartment or respectively located in different compartments, and if the shafts of the respective pulleys of the revolving chains of buckets are axially in line, these shafts may be connected, and thus form a continuous shaft. If said shafts are not axially in line, they may be connected by suitable gear and their power be cumulatively applied, or the power of each separate shaft may be directly applied to its own set of machinery without any reference to or connection with the other shafts, so that one compartment of the engine may be located in one place and another in another and connected only by jacketed pipe conveying the actuating-fluid. The actuating-fluid, vapor, steam, or other gas may be drawn from any vessel in which it is compressed, or be furnished by the action of heat in a suitable furnace and boiler, either within or without the enveloping-case of the entire engine, if the several compartments are all located within the one case. I have shown a furnace, F, located near the bottom of the first of the series of compartments B.

In the furnace there shown I burn a suitable mixture of combustible gas, (coal gas, gasoline vapor, hydrogen, water gas, &c.,) with either atmospheric air or oxygen, which is either forced or drawn into the combustion-chamber *u*.

One mode of starting such combustion and of carrying it on (and which is of my own invention) is as follows, viz: This mixture of combustible gas and a gaseous supporter of combustion when it begins to pass through service-pipe T ending in nozzle *t*, which is provided with the gauze-wire diaphragms *t′*, is ignited at the outer surface of the outer of these diaphragms *t′*, and the nozzle *t* is then inserted into the combustion-chamber *u* of the furnace F through the incasing-pipe t^2, which the said nozzle *t* more or less completely fills or closes. The gases of combustion pass out from the combustion-chamber *u* through the interiorly-connected series of tubes V into a regenerator, Z, of any well-known form, in which the heat of the gases of combustion are to a greater or less extent absorbed by either the combustible gas of the supporter of combustion, or both, shortly previous to their ignition.

H indicates a governor, actuated by the power-shaft S, operated by the series of buckets, and W indicates the valve actuated by the governor and located in the service-pipe T, and regulating the flow of mixed combustible and supporter of combustion.

M M are braces supporting the service-pipe T, with governing-valve W and their connections. The continuation of that portion of this pipe which is below the braces M consists of a flexible pipe, U, terminating in a nozzle, *t*, whose end is provided with the wire-gauze diaphragm *t′*, as before mentioned. The service-pipe T has its branches T′ and T^2 each provided with its own stop-cock, through

one of which pipes the combustible gas or vapor and through the other the supporter of combustion are conveyed into service-pipe T. The space above the furnace F may be utilized by fitting it up with a series of buckets, pulleys, &c., as in the other compartments. In that case it is desirable to provide the perforated diaphragm Y to catch the actuating gas or vapor and deliver it directly into the buckets without waste on either side.

The compartments B are to be provided with the usual apparatus for testing the height of the liquid in the compartment, and with suitable escape-cocks, and blow-off cocks, and man-holes, and pressure-gages, and the like; but as these are well known and form no part of my invention all further mention of them is omitted.

In each compartment that shaft which passes through the wall or walls of the compartment to the space outside thereof is provided at its junction with the wall of the compartment with the usual packing, to prevent the fluid which is in the compartment from escaping through the orifice through which the shaft passes. When the compartments are so situated with reference to one another, as shown in Figs. 1 and 3 and 11, and one shaft, as upper shaft, S, passes through them all, then the space between two adjacent compartments may be provided with one packing-box, serving to close both the adjacent annular leakage-orifices around said shaft.

For the purpose of lubrication, and for other purposes, it is desirable in many cases to float an oil to any desired depth on the top of the bath.

One special service rendered by this supernatant oil is the more or less complete prevention of both circulation and ebullition of any liquid beneath it of lower boiling-point, such as water.

In many cases it is very desirable to employ as the liquid of the bath one whose boiling-point or whose specific gravity, or both, is greater than that of the liquid whose vaporization in a proper boiler furnishes the actuating gas or vapor. This engine, with its condenser, is specially qualified to utilize to the greatest advantage the vapors of very volatile liquids, such as gasoline, ammonia, carbonic sulphide, wood-alcohol, and the like. The special adaptation of this engine to the conservation and utilization of the energy of compressed air is obvious.

I have mentioned the motions of rarefied liquid as one of the actuating agencies employed in this invention. This I now more particularly explain. This agency differs from the others in that its action is confined to the compartment in which it moves—that is, it does not pass over from one compartment into another like the gases and vapors.

It will be noticed that the heated gas or vapor is delivered on that side of the center of the compartment occupied by the ascending part of the endless series of buckets when the said series is in operation. When the two columns of the liquid both communicate at the top as well as at the bottom, there will be more or less vertical circulation of the liquid of the bath. In that case the rarefied portions of the liquid will ascend the channel R′, Figs. 2 and 9, above the pipe which conveys the actuating gas or vapor into the compartment and pass across the top of the bath and down the channel R on the opposite side in the direction of the motion of the chain of buckets, thus assisting the motion of the said chain of buckets.

I will now proceed to describe the operation of my invention.

The compartments B, Figs. 1, 2, and 11, are first nearly filled all with the same liquid, or some with different liquids, such as water, oil, tar, alloys of low fusion, mercury and its liquid amalgams, and the like. Air or oxygen is then forced through the tube T′ into its continuation T, where its mixes with the combustible gas or vapor supplied through the tube T^2. The mixed gases then pass through the open governor-cock W into the flexible continuation U of the said pipe T to the nozzle *t*. The mixed gases pass through the series of wire-gauze diaphragms *t′*, and are ignited at the outer surface of that one of the series of diaphragms which is farthest from the flexible tube U. The nozzle *t* is then inserted through the incasing-pipe t^2 into the combustion-chamber *u* of the furnace F, where the heated gases of combustion give out through the walls of the chamber part of their heat to the liquid in contact with the exterior surface or surfaces of said chamber. In the further progress of the gases of combustion through the tubes V of the furnace F they give out a large part of their remaining heat to the liquid in contact with the exterior surfaces of the said tubes. The gases of combustion then pass out through the case A of the boiler or engine, and in their further passage through the incasing-tube of the regenerator Z they give out nearly all their remaining heat above that of the atmosphere to the air passing through the incased tube T′. After the liquid contents of this first compartment B have been heated to their boiling-point, the gas or vapor of that liquid is formed at the surface of the furnace F, and rising through the liquid impinges upon the bottom of the perforated diaphragm Y. This diaphragm Y conducts the gas or vapor to the perforation shown in said diaphragm, whence the gas or vapor escapes upward into the partially-inverted bucket immediately above it, or else it impinges upon the lower face of that bucket. If it escapes into the bucket, (see Fig. 13,) the bucket may become partially filled, the surface of the fluid within the said bucket lowering until it reaches the lower end of the conduit *k*, through which any gas or vapor received later while the bucket is in that position will escape upward through the said conduit into the bucket immediately above it. If the bucket be in such

position that the actuating gas or vapor impinges upon the lower face, *e*, of the bucket, (see Fig. 14,) the gas or vapor is guided by the flanges *g* upward through the channel *f*, composed of the face *e* and the flanges *g*, (or their equivalents,) into the bucket next above. This process of conduction of the actuating gas or vapor from one bucket to the next above it, and from that to its predecessor, continues until such time as the buoyancy of the buckets thus filled causes the endless chain of buckets to begin its revolution around its two pulley-shafts. When each bucket thus more or less completely filled with the actuating gas or vapor reaches the proper point in the upper part of its revolution, it discharges its gases or vaporous contents, which go to increase the pressure of the gas or vapor in the upper part of that compartment. When this gas or vapor in the upper part of the first of the series of compartments attains sufficient pressure, it forces downward and into the second of the series of compartments B so much of the liquid of the bath of that compartment as had before stood at the same level in the conduit D. In this operation the compressed gas or vapor in the first compartment passes into conduit D through the aperture *d* of wall C of the first compartment, and after traversing conduit D, following the liquid, which it pushes before it into the second compartment through the aperture *d'* and conducting-pipe d^2, enters this second compartment B, and is delivered at the proper point beneath the endless series of buckets of that compartment. These buckets fill and ascend the same as the buckets in the first compartment. When the pressure in the upper part of this compartment becomes sufficiently great, the compressed gas likewise passes through its appropriate conduit into the next following compartment of the series, and so on until the actuating-vapor has passed *seriatim* through all the compartments; thence it is emitted into the outer air or into a condenser. The buoyant power of the actuating gas or vapor is thus brought to bear in each compartment upon the common shaft S, which communicates the power thus derived to the machinery to be operated.

It will be noted that if any bucket while well down toward the bottom of the compartment be filled with the actuating gas or vapor nearly or quite down to the bottom of conduit *k* of the bucket, the contained actuating gas in its expansion during the upward progress of the bucket through its bath but for the conduit *k* might partially escape from beneath the lower edge of the bucket and pass freely and inutilly up through the bath. The conduit *k*, however, in this case performs the useful service of conducting any excess of gas or vapor due to expansion from that bucket up to the one above it. The passage of gas or vapor directly and inutilly through from the upper part of one compartment to the upper part of the next adjoining compartment through the opening used by the shaft S is prevented by the packed boxing about the shaft, as shown in Fig. 1.

When it is desirable to economize as much as possible the liquid used as the bath, the conduit D may be made one continuous tube from *d* to the end of d^2. If an oil is the liquid used as the bath, it may advantageously lubricate the shafts in or passing through the compartment; or if oil constitute the upper portion of the bath it may then advantageously lubricate the upper shaft, S.

It is desirable to construct each succeeding compartment after the first one larger than its predecessor in the series and to fit it with a larger series of buckets to accommodate and employ the expansion of the actuating gas or vapor as it approaches atmospheric pressure or the pressure in the condenser, as the case may be.

It will be noticed that this form of motor is especially adapted to be used advantageously with a condenser of any well-known pattern, since it can with increasing profit use the actuating gas or vapor entirely down to any temperature and pressure obtained in the condenser.

While the various features of my invention are preferably employed together, one or more of said features may be employed without the remainder, and, in so far as practicable, one or more of the said features may be employed in connection with motors of descriptions other than those herein particularly set forth.

What I claim as new and of my invention, and desire to secure by Letters Patent, is—

1. In a motor, the compartment B, a liquid therein, an endless series of buckets partially or wholly immersed in said liquid, and a device for directing the rarefied portions of the said liquid or any gas or vapor to and into the said buckets, the bucket being provided with channels *f*, substantially as and for the purposes specified.

2. In a motor, the compartment B, a liquid therein, an endless series of buckets partially or wholly immersed in said liquid, and a device for directing the rarefied portions of the said liquid or any gas or vapor to and into the said buckets, the buckets being provided with conduit *k*, located against or near the face of said buckets which is innermost when the buckets are coupled in said series, substantially as and for the purposes specified.

3. In a motor, the compartment B, a liquid therein, an endless series of buckets partially or wholly immersed in said liquid, and a device for directing the rarefied portions of the said liquid or any gas or vapor to and into the said buckets, the buckets being provided with channel *f* and conduit *k*, substantially as and for the purposes specified.

4. In a motor, the endless series of buckets wholly or partially submerged in the liquid, the buckets being respectively provided with the notch or recess *p*, substantially as and for the purposes specified.

5. In a motor, the endless series of buckets

wholly or partially submerged in the liquid, the buckets being provided with the notch or recess *p* and the conduit *k*, substantially as and for the purposes specified.

6. In a motor, the endless series of buckets wholly or partially submerged in the liquid, the buckets being provided with the notch or recess *p*, the conduit *k*, and the channel *f*, substantially as and for the purposes specified.

7. In a motor, the bucket provided with the conduit *k* and the channel *f*, the latter formed by the flanges *g*, substantially as and for the purposes specified.

8. An endless series of buckets in which the bucket is provided with the projections *m*, located at the closed end of the said bucket, and perforated at or near the central line of said bucket, the closed end of one bucket entering the open end of the preceding bucket, substantially as and for the purposes specified.

9. In a motor, the endless chain of buckets connected together by the rods *n* and the wheels S′, with the peripheral projections and suitably connected to shaft S, the said rods *n* lying in the median plane of motion of the said buckets in their upward and downward passage, substantially as and for the purposes specified.

10. In a motor, a compartment partially occupied by the central piece, Q, and the endless chain of buckets embracing said piece and moving around the latter, substantially as and for the purposes specified.

11. In a motor, a compartment having the grooves *g′* and the endless chain of buckets having channels *f* and flanges *g*, substantially as and the purposes specified.

12. In a motor, an endless chain of revolving buckets, a bath composed of mercury or its fluid amalgams, an actuating gas or vapor, and the central piece, Q, substantially as and for the purposes specified.

13. In a motor, an endless chain of revolving buckets, a bath composed of mercury or its fluid amalgams, an actuating gas or vapor, and grooves G′, substantially as and for the purposes specified.

14. In a motor, an endless chain of revolving buckets, a bath composed of mercury or its fluid amalgams, an actuating gas or vapor, and offsets X, substantially as and for the purposes specified.

15. In a motor having a series of contiguous compartments each with an endless series of buckets in a bath and actuated by the buoyancy of a submerged gas or vapor, a common shaft around which the series of buckets revolve, substantially as and for the purposes specified.

16. In a motor, a series of compartments, B, each with an endless series of buckets in a bath and actuated by the buoyancy of a submerged gas or vapor, the double walls C C, the conduit D, to convey the actuating gas or vapor from the top of one of the series of compartments to the next following of the series of compartments, and a packing-box common to both walls C C, substantially as and for the purposes specified.

17. In a motor, the bath containing liquid to be rarefied by heat, the endless series of buckets, a furnace for burning a gas and provided with inlet-pipe t^2, and flexible feed-tube U, provided with nozzle having gauze diaphragms *t′*, substantially as and for the purposes specified.

18. In a motor operated by the buoyancy of a submerged gas or vapor, or by the motions of a rarefied liquid by means of an endless series of buckets, the governor connected with the fuel-supply and connected to and operated by the power-shaft of the said motor, substantially as and for the purposes specified.

19. The combination of the governor H and the power-shaft, and the series of buckets operating said shaft, and the furnace and the fuel-supply service-pipe, and valve W, located in said service-pipe and operated by said governor, substantially as and for the purposes specified.

20. In a motor operated by the buoyancy of a submerged gas or vapor, or by the motions of a rarefied liquid by means of an endless series of buckets, the governor connected with the fuel-supply and the brackets M M, connected to the case A, substantially as and for the purposes specified.

21. In a motor operated by the buoyancy of a submerged gas or vapor, or by the motions of a rarefied liquid by means of an endless series of buckets, the furnace F and the regenerator Z, and the governor H, substantially as and for the purposes specified.

22. In a motor containing a bath and operated by the buoyancy of a submerged gas or vapor, a number of successive series of buckets immersed partially or wholly in the liquid of the bath, the buckets in any given series being larger than those of the series preceding it and smaller than those of the series following it, substantially as and for the purposes specified.

23. In a motor operated by the buoyancy of a submerged gas or vapor, the combination of the compartment containing a bath of liquid in which a series of buckets operates and the offset X, substantially as and for the purposes specified.

24. In a motor operated by the buoyancy of a submerged gas or vapor, the combination of the compartment containing a bath of liquid in which a series of buckets operates and the offset X, and flange *q*, the compartment, offset, and flange being cast in one piece, substantially as and for the purposes specified.

DELOS R. BAKER.

Witnesses:
O. M. HILL,
W. P. GULICK.